ROAD FORK and COGAR HOLLOW

MONITORING PLAN

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I. Introduction

Fola Coal Company (Fola) has prepared a monitoring plan for the acquisition of flow and specific conductance data from surface water, groundwater and permitted discharge locations in the Road Fork and Cogar Hollow tributaries of Leatherwood Creek. As directed by the court, the data collected throughout the monitoring program will be used to evaluate the following remedy options:

1. Diversion of valley fill underdrain water to Leatherwood Creek
2. Diversion of valley fill underdrain water to the Elk River
3. Construction of a Reverse Osmosis water treatment facility

Flow and specific conductance data from all Road Fork and Cogar Hollow monitoring locations will be collected over an entire hydrologic cycle in order to develop a robust engineering design strategy for any of the alternatives listed above. Monitoring will commence upon completion of weir and level logger installation by June 23, 2016.

II. Flow and Specific Conductance Monitoring

To determine the expected flow rates, combination V-notch/rectangular weirs will be installed at multiple locations associated with discharges in Road Fork and Cogar Hollow (Figure 1). This type of weir has proven to be accurate over a wide range of flows. The weirs will be equipped with continuously recording level loggers (pressure transducers) that record the height and therefore the flow of water moving through the weir. The level loggers are also equipped with 4 electrode platinum conductivity sensors and temperature detectors. Level loggers will be housed in a PVC stilling well located in the pool upstream of the weir.

Level loggers will be programmed to record a water level reading, temperature, and specific conductance normalized to 25°C every 30 minutes. The level logger data will be downloaded twice per month, for a period of one year. During field visits, staff gauge and field conductivity measurements will be taken to verify the level loggers' calibration. Data files downloaded from the loggers will be stored on secure servers. A manufacturer approved Excel program will be used to convert the level readings to flow readings for each of the weirs.

Flow and specific conductance monitoring will also be conducted at the mouths of Road Fork and Cogar Hollow. Because the mouths of each stream are located outside permit boundaries, placement of instream weirs and level loggers will require approval from the U.S. Army Corps of Engineers (USACE). To avoid delays while Fola pursues USACE approval, manual stream flow measurements will be taken by a member of Fola's environmental staff in accordance with Measurement and Computation of Streamflow, U.S. Geological Survey, Water Supply Paper 2175. Weirs and level loggers will be installed at the stream mouth sampling location as soon as possible after USACE approval.

The flow data will be combined with daily precipitation data collected from the rain gauge located at the Fola office to develop a site specific hydrologic model. The model will consist of three components: surface runoff, infiltration/evapotranspiration, and groundwater flow. The model, based on the surface

runoff and infiltration estimation equations and capabilities of EPA's Stormwater Management Model (PCSWMM), will incorporate the Road Fork and Cogar Hollow drainage areas and will be calibrated using weir data. In conjunction with the drainage area, rainfall measured during the one year monitoring period will be applied to the base model. For each tributary, the model output will provide the proportion of daily flow associated with groundwater seepage and runoff. Hydrographs will be maintained and periodically updated during the project.

Figure 1. Representative Combination V-Notch Rectangular Weir

III. Water Quality Sampling and Analysis

Twice per month, water quality samples will be collected at the Road Fork and Cogar Hollow locations identified in sections IV, V and VI below. The samples will be submitted to a WVDEP certified laboratory for specific conductance analysis.

IV. Road Fork Valley Fill and Outlet Monitoring Locations

The proposed monitoring locations associated with each valley fill and outlet 001 are described below and depicted in Attachment 1 *(see page 2)*. Pond 1 on Fola's Surface Mine 2 (WV1013840) discharges through permitted outlet 001 to Road Fork. Pond 1 receives groundwater drainage from three valley fills: Valley Fill D, Valley Fill C, and Valley Fill B.

- Valley Fill D: Water exits the toe of Valley Fill D in the form of multiple groundwater seeps. The flow combines in a sump at the toe of the valley fill and then discharges to a culvert constructed beneath a main access road. The culvert discharges to a second sump and is subsequently

conveyed to pond 1. A weir, identified as "RF-VFD-W," will be placed in the channel immediately upstream of pond 1. *(see Attachment 1, page 3)*

- Valley Fill C: Water exits the toe of Valley Fill C in the form of multiple ground water seeps. The flow combines in a sump at the valley fill toe. Water exits the sump and enters a constructed channel that conveys flow from Valley Fill C to the bottom of adjacent Valley Fill B. A weir, identified as "RF-VFC-W," will be placed in the channel conveying flow toward the toe of Valley Fill B. *(see Attachment 1, page 4)*

- Valley Fill B: Water exiting the toe of Valley Fill B in the form of multiple groundwater seeps immediately combines with the directed drainage from Valley Fill C and enters a large sump. The combined drainage from Valley Fills B and C is conveyed to pond 1 through a constructed channel. As a result of the comingled drainage, direct measurement of the flow exiting the toe of Valley Fill B is not possible. A weir, identified as "RF-VFBC-W," will be placed in the channel conveying the combined drainage to pond 1. The flow exiting Valley Fill C will be calculated by subtracting the Valley Fill C flow measured at RF-VFC-W from the combined flows measured at RF-VFBC-W. An additional sample of the groundwater exiting the toe of Valley Fill B will be collected in addition to the biweekly water quality samples collected at the weir locations *(see Attachment 1, page 4)*

- Outlet 001: Water exits pond 1 via a wide channel grouted spillway at outlet 001. The flow at outlet 001 will be measured at an existing weir located at the bottom of the grouted channel, identified as "RF-001-W." *(see Attachment 1, page 5)*

V. Cogar Hollow Valley Fill and Outlet Monitoring Locations

Outlets 013, 015, and 017 on Fola's Surface Mine 6 (WV1018001) discharge to Cogar Hollow. Outlet 013 receives groundwater drainage from Valley Fill 2, outlet 015 receives groundwater drainage from Valley Fill 1, and outlet 017 receives drainage from Valley Fill 3. The proposed monitoring locations associated with each valley fill and outlet are described below and depicted in Attachment 2.

- Valley Fill 2: Water exits the toe of Valley Fill 2 in the form of multiple groundwater seeps. The flow combines in a channel that directs water to the pond associated with outlet 013. A weir, identified as "CH-VF2-W," will be placed in the channel upstream of the outlet 013 pond. *(see Attachment 2, page 3)*

- Outlet 013: Water discharges from outlet 013 via a wide channel grouted spillway. The flow at outlet 013 will be measured at an existing weir located at the bottom of the grouted channel, identified as "CH-013-W." *(see Attachment 2, page 3)*

- Valley Fill 1: Water exits the toe of Valley Fill 1 in the form of multiple groundwater seeps. The flow combines in a sump at the toe of the valley fill and then discharges to a culvert constructed

beneath a main access road. The culvert discharges to a second sump and is subsequently conveyed to the pond associated with outlet 015. A weir, identified as "CH-VF1-W" will be placed in the channel immediately upstream of pond 1. *(see Attachment 2, page 4)*

- Outlet 015: Water discharges from outlet 015 via a wide channel grouted spillway. The flow at outlet 015 will be measured at an existing weir located at the bottom of the grouted channel, identified as "CH-015-W." *(see Attachment 2, page 4)*

- Valley Fill 3: Water exits the toe of Valley Fill 3 in the form of multiple groundwater seeps. The water exits the valley fill and immediately combines with drainage from a seep originating alongside the adjacent main access road. The combined drainage directly enters the pond associated with outlet 017. Consequently, a weir placed at the toe of Valley Fill 3 would not provide a segregated valley fill toe flow measurement. To measure the flow contribution from the side seepage alongside the main access road, a weir identified as "RF-VF3SS-W" will be placed in the seepage collection channel. The flow exiting Valley Fill 3 will be calculated by subtracting the flow measured at RF-VF3SS-W from the flow measured at outlet 017. An additional sample of the groundwater exiting the toe of Valley Fill 3 will be collected in addition to the biweekly water quality samples collected at the weir locations *(see Attachment 2, page 5)*

- Outlet 017: Water discharges from outlet 017 via a wide channel grouted spillway. The flow at outlet 017 will be measured at an existing weir located at the bottom of the grouted channel, identified as "CH-017-W." *(see Attachment 2, page 5)*

VI. Instream Monitoring Locations

In addition to the valley fill source waters and permitted outfalls, flow and specific conductance measurements will be collected at the mouths of Road Fork and Cogar Hollow (Figure 2).

Figure 2. Proposed Stream Mouth Monitoring Locations

VII. Reporting

Throughout the year long monitoring and analysis plan, Fola will submit interim quarterly progress reports to the Special Master. The quarterly reports will include all flow and analytical data collected and will be submitted no later than twenty days after the end of the quarter.